VOLUME 7

REGIONAL CONDITIONS

SITE PROPOSAL
SUPERCONDUCTING SUPER COLLIDER

STATE OF
MONTANA

COMANCHE BASIN

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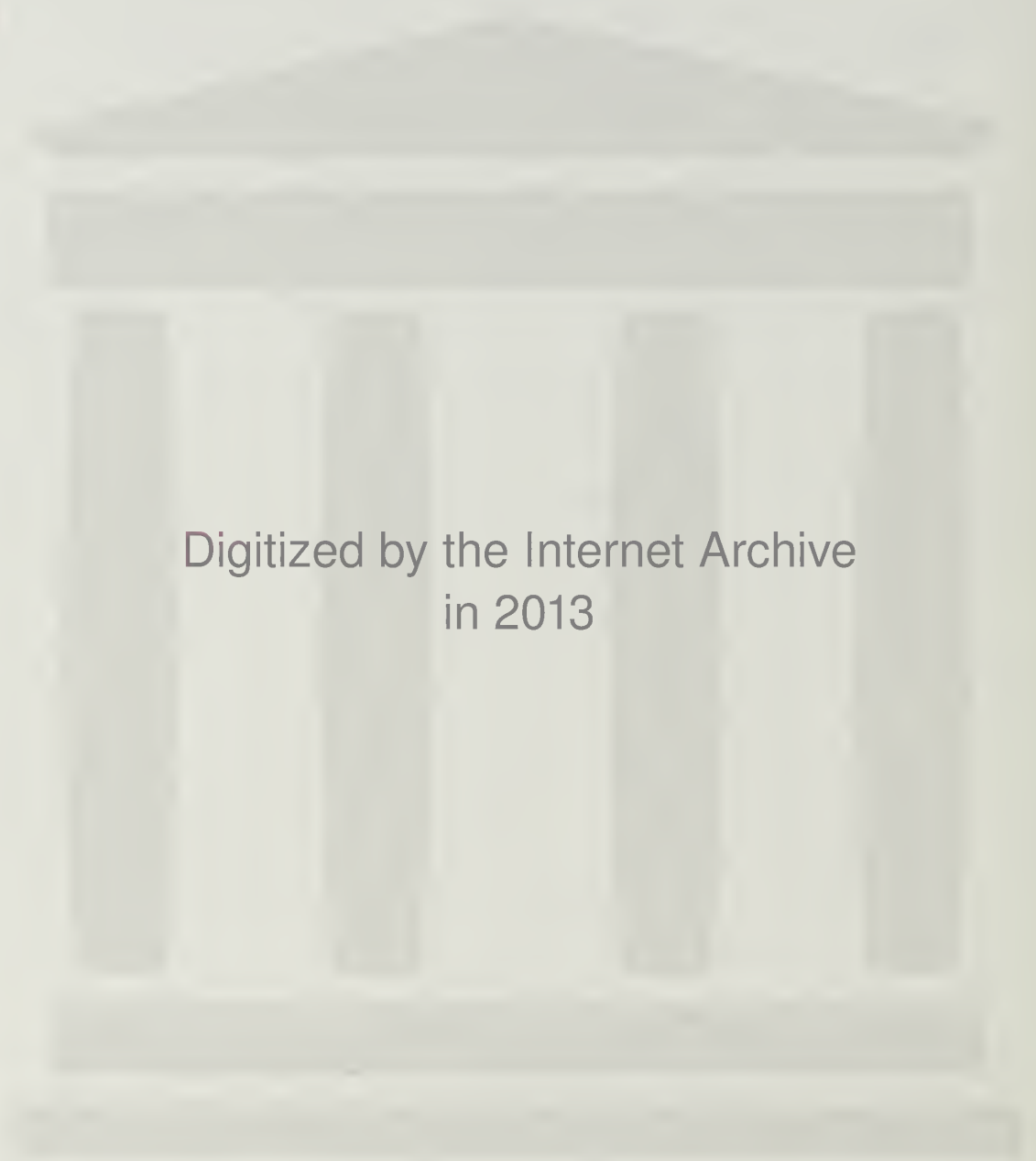

VOLUME 7

REGIONAL CONDITIONS

Positive regional conditions add to the attractiveness of the Comanche Basin site.

No problem vibration exists at the site. The railroad and highway are over five miles from interaction points.

There is no mining, blasting, heavy trucking in the area.

No sensitive noise receptors exist near the site.

The region enjoys moderate temperatures, high percentage of sunny days, low precipitation and humidity.

Chinook winds bring frequent periods of warm weather during winter.

Accumulated snowfall rarely exceeds six inches and rarely leads to closing of roads or the airport.

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REGIONAL CONDITIONS

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7.1 VIBRATION

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REGIONAL CONDITIONS

7.1 VIBRATION

The existing sources of vibration in the Comanche Basin include automobile traffic on the highway and the county roads in the area, trains traveling on the railroad which traverses the basin, and operation of agricultural machinery by farmers in the area.

Because the area is rural and agricultural, there are fewer sources of vibration than in more populated areas. Automobile traffic in the Comanche Basin is mostly confined to State Highway 3, which crosses the basin from Acton to Broadview. The average volume of traffic on this highway is 1450 to 1800 vehicles per day (Duset, 1987). Nowhere is the highway closer than about five miles to the interaction points on the collider ring. The county roads in the basin are primarily used by farmers and ranchers in the area for access to their property. There is much less traffic on the county roads than on Highway 3. Because the county roads generally are unpaved, traffic is slower as well.

On average, one to two trains use the Burlington Northern Railroad line each day (Keim, 1987). These trains generally are about 80 cars in length and travel about 60 miles per hour as they cross the basin. The closest approach of the railroad tracks to the interaction points on the collider ring is about five miles.

The farmers in the Comanche Basin use heavy machinery, including tractors, cultivators, and combines, to cultivate and harvest their crops. Such activities probably would not take place near the interaction zones, however, because of the presence of the campus facilities in these areas.

7.2 NOISE

The Comanche Basin is a rural, agricultural area which does not experience unusual levels of background noise. The principal sources of noise in the area are automobile traffic on Highway 3, train traffic on the railroad line which crosses the basin, and noise from the agricultural machinery used by farmers in the area. Noise from aircraft taking off from the Billings Airport will occasionally be audible, but since the principal corridors used by aircraft are 10 to 15 miles from the Comanche Basin, aircraft noise should not be objectionable. There are no sensitive receptors such as hospitals in the Comanche Basin.

Levels of noise in the Comanche Basin will increase during construction of the SSC, primarily because of the heavy machinery to be used and the increase in traffic to the construction sites. After the SSC is in place, there will be some increase in noise above current levels because of the increased automobile traffic in the area.

7.3 CLIMATIC CONDITIONS

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The climate of Billings, Montana, is strongly influenced by the nearby Rocky Mountains, which moderate the continental type of weather. Air moving eastward from the Pacific Ocean flows over the Rocky Mountains, and when this air descends the eastern slopes of these mountains, it is compressed and becomes warmer. As a result, south-central Montana enjoys a climate that is mild compared with cities of similar latitude to the east. The average January temperature in Billings, for example, is nine degrees warmer than Minneapolis (see Figure 7.3-1).

Mild weather during the winter occurs when warm "chinook" winds blow from the Rocky Mountains. Occasionally, colder arctic air arrives from the north, but cold periods generally are short, usually lasting for no more than 3 or 4 days. Billings frequently has mild, "open" winters when arctic cold bypasses the area completely. Snowfall generally is light because of the frequent periods of warm weather, and snow seldom accumulates to significant depths. During the winter, the ground normally is free of snow about 34 percent of the time (see Table 7.3-6).

Spring generally brings rapid changes in the weather, with frequent periods of sunny, mild weather and occasional periods of rain or wet snow. The last spring frost in the area normally occurs in mid-May.

Summers are warm, sunny, and dry, with occasional afternoon and evening thunderstorms. High temperatures in the summer normally are in the 80's. Unpleasantly hot weather is uncommon. Because of the low humidity, summer nights are cool, with low temperatures normally in the 50's.

During autumn, the days are mild and the nights cool. The first frost of the autumn season generally occurs about September 25, and is typically followed by an "Indian summer." The transition to winter usually takes place in late November or early December.

Records of meteorological conditions, including temperature, humidity, precipitation, and wind, have been kept by the National Weather Service (NWS) at Billings Logan International Airport since 1934. This airport, approximately 15 miles southeast of the proposed site, at an elevation of 3567 feet, is in an area topographically similar to the site, and consequently the data collected there are representative of the Acton-Broadview area. Table 7.3-1 provides a summary of monthly and annual average temperature, humidity and precipitation for the period 1951-1980, as recorded at Billings Logan International Airport.

Records of temperature and precipitation have been kept by a cooperative observer at Broadview for the National Oceanic and Atmospheric Administration (NOAA) since 1951. These data, while less comprehensive than those from the Billings Airport, provide the most representative data for the site. Summaries of monthly and annual climatological normals, means, and extremes for these two locations for the standard climatological averaging period of 1951 through 1980 are shown in Tables 7.3-2 and 7.3-3.

7.3.1 Temperature, Humidity, and Precipitation

Average annual temperature, humidity, and precipitation for Billings is shown in Table 7.3-1. During the winter months of December, January, and February, average high temperatures in Billings range from 29.9 degrees in January to 37.9 degrees in February. The average low temperatures range from 11.8 degrees in January to 18.8 degrees in February.

The high temperature normally is 32 degrees or higher on an average of 19 days in December, 16 days in January, and 20 days in February. The low temperature typically is 32 degrees or colder on 28 days in December and January, and 24 days in February. Low temperatures below zero normally occur on 5 days in December, 9 days in January, and 3 days in February.

At Broadview during the winter, average high temperatures range from 32.3 degrees in January to 39.4 degrees in February. The average low temperatures vary from 7.9 degrees in January to 15.5 degrees in February.

In the spring months of March, April, and May, average monthly high temperatures in Billings warm from 44.0 degrees in March to 66.4 degrees in May. The average monthly low temperatures range from 23.6 degrees in March to 43.3 degrees in May. The high temperature normally is less than 32 degrees on an average of 5 days in March and 1 day in April. Low temperatures of 32 degrees or colder normally occur on 24 days in March, 13 days in April, and 2 days in May. Low temperatures below zero normally occur on 1 day in March.

During the spring at Broadview, average monthly high temperatures increase from 45.5 degrees in March to 67.0 degrees in May. The average monthly low temperatures range from 19.9 degrees in March to 39.9 degrees in May.

Table 7.3-1

Average Temperature, Humidity, and Precipitation

Billings WSO AP, Montana

1951 - 1980

	Temperature			Humidity				Precipitation	
	Ave	Ave		Hour (Local time)				Ave	Ave
Month	High	Low	Ave	5	11	17	23	Precip	Snow
Jan	29.9	11.8	20.9	65	61	57	64	0.97	11.6
Feb	37.9	18.8	28.4	65	58	51	62	0.71	8.2
Mar	44.0	23.6	33.8	68	54	46	62	1.05	10.1
Apr	55.9	33.2	44.5	67	48	40	58	1.93	9.2
May	66.4	44.3	54.9	69	48	42	59	2.39	1.2
Jun	76.3	51.6	64.0	71	46	40	59	2.07	0.0
Jul	86.6	58.0	72.3	63	39	31	49	0.85	0.0
Aug	84.3	56.2	70.3	61	39	30	46	1.05	0.0
Sep	72.3	46.5	59.4	65	48	38	54	1.26	1.0
Oct	61.0	37.5	49.3	63	49	42	56	1.16	3.8
Nov	44.4	25.5	35.0	66	58	54	62	0.85	7.3
Dec	36.0	18.2	27.1	65	61	58	63	0.80	9.4
Year	57.9	35.4	46.6	66	51	44	58	15.09	62.0

Sources: Local Climatological Data Annual Summary with Comparative Data. Billings, Montana, 1985; Climatological Data Montana 1951 - 1980.

Table 7.3-2

Average Temperature and Precipitation

Broadview, Montana

1951 - 1980

Month	Temperature			Precipitation	
	Ave High	Ave Low	Ave	Ave Precip	Ave Snow
Jan	32.3	7.9	20.1	0.59	8.4
Feb	39.4	15.5	27.3	0.46	6.8
Mar	45.5	19.9	32.8	0.71	6.3
Apr	55.8	30.0	43.2	1.57	6.5
May	67.0	39.9	53.6	2.65	0.2
Jun	76.2	47.7	62.0	2.45	0.0
Jul	86.0	53.1	69.6	0.97	0.0
Aug	84.3	51.1	67.7	1.30	0.0
Sep	72.3	41.7	57.1	1.22	0.4
Oct	62.3	33.2	47.8	0.99	2.3
Nov	45.6	21.4	33.5	0.64	6.6
Dec	38.5	14.6	26.8	0.43	4.6
Year	58.8	31.3	45.1	13.99	42.1

Source: Climatological Data Montana 1951-1980.

Table 7.3-3

Average Degree-Days, Frost Penetration, and Snow Depth

Billings WSO AP, Montana

Month	Average Degree Days (Base 65°F) Heating	Cooling	Average Frost Penetration (inches)	Average Snow Depth (inches)
Jan	1367	0	8-20	3.2
Feb	1025	0	8-20	2.3
Mar	967	0	0-4	1.3
Apr	612	0	0	0.3
May	318	0	0	0.0
Jun	111	81	0	0.0
Jul	9	235	0	0.0
Aug	27	191	0	0.0
Sep	214	46	0	0.0
Oct	487	0	0	0.1
Nov	900	0	0-4	0.9
Dec	1175	0	8-20	1.9
Year	7212	553	----	0.8

Source: Local Climatological Data Annual Summary With Comparative Data Billings, Montana, 1985.

Average monthly high temperatures in Billings during the summer months of June, July, and August range from 76.3 degrees in June to 86.6 degrees in July. The average monthly low temperatures range from 51.6 degrees in June to 58.0 degrees in July. The high temperatures in Billings are 90 degrees or higher on an average of 3 days in June, 13 days in July, and 11 days in August.

At Broadview, the average monthly high temperatures in summer range from 76.2 degrees in June to 86.0 degrees in July. The average monthly low temperatures at Broadview during the summer range from 47.7 degrees in June to 53.1 degrees in July.

During the autumn months of September, October, and November, the average monthly high temperatures in Billings vary from 72.3 degrees in September to 44.4 degrees in November. The average monthly low temperatures during the autumn vary from 46.5 degrees in September to 25.5 degrees in November. The high temperatures in Billings are 90 degrees or greater on an average of 2 days in September. High temperatures of 32 degrees or less occur on an average of 1 day in October and 6 days in November. Low temperatures are 32 degrees or colder on an average of 2 days in September, 8 days in October, and 22 days in November. Low temperatures below zero normally occur on one day in November.

During the autumn months at Broadview, the average monthly high temperatures range from 72.3 degrees in September to 45.6 degrees in November. The average monthly low temperatures in Broadview during the autumn range from 41.7 degrees in September to 21.4 degrees in November.

The average relative humidity during the nighttime hours is nearly constant throughout the year. At the Billings Airport, the average monthly relative humidity during hour 5 ranges from 61 percent in August to 71 percent during June. During hour 23, the average monthly relative humidity ranges from 46 percent in August to 64 percent in January.

Relative humidity during the daylight hours varies more from month to month, with the summer months being the driest. The average monthly relative humidity during hour 11 varies from 39 percent in July and August to 61 percent in December and January. During hour 17, the average monthly relative humidity ranges from 30 percent in August to 58 percent in December.

The average annual precipitation at the Billings Airport is 15.09 inches. About half of the year's precipitation normally falls in April through June. May is the wettest month at Billings, with an average precipitation of 2.39 inches. February is the driest month at the Billings Airport, with an average precipitation of 0.71 inches.

At Broadview, the average annual precipitation is 13.99 inches. May is the wettest month with an average precipitation of 2.65 inches. December, with an average precipitation total of 0.43 inches, is the driest month.

7.3.2 Degree-Days, Frost Penetration, and Snowfall

The normal monthly heating degree days at the Billings Airport range from 1367 in January to 9 during July. The normal yearly total heating degrees days is 7212. Nearly half the total annual degree days are accumulated during December, January, and February. The normal monthly cooling degree day total is zero during all months except June, July, August, and September. The greatest monthly average cooling degree day total is 225 in July. The normal yearly cooling degree day total is 553.

During most winters in the area, frost penetrates 8 to 20 inches into the soil. During especially severe winters, the soil may occasionally freeze to depths of 40 to 48 inches. To prevent freezing, water lines generally are buried 72 inches deep (Williams, 1987). Daily soil temperature data from the Huntley Experiment Station 20 miles east of the site indicate that monthly average soil temperatures at depths of 2 and 4 inches below the surface are below freezing only during December, January, and February. At 8 inches below the surface, monthly average soil temperatures are below freezing only during January and February. At greater depths below the surface, average soil temperatures remain above freezing throughout the winter (see Tables 7.3-4 and 7.3-5).

The normal annual snowfall at the Billings Airport is 62.0 inches. Most of the snow falls between December and April. Monthly average snowfall varies from 0.0 inches in June, July, and August to 11.6 inches in January. December through March are the snowiest months. Measurable snow normally falls on 7 to 9 days during each of these months. During November and April, measurable snow normally falls on about 5 days in each month, and it normally snows on one day in May and September.

Table 7.3-4

Average Soil Temperatures (deg F)

Huntley Experiment Station

Huntley, Montana

1961 - 1980

Depth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	30.2	30.8	35.9	45.6	55.9	66.9	74.0	71.4	60.0	48.0	36.0	30.2
4	29.5	30.6	35.5	45.3	55.4	66.1	73.4	70.7	60.5	49.2	37.6	31.2
8	30.8	31.4	35.1	44.3	53.4	63.6	70.7	68.8	59.6	49.7	38.8	32.8
20	33.8	33.3	35.2	42.1	50.7	58.9	65.8	65.2	59.9	52.1	42.8	36.4
40	38.8	37.1	37.3	41.5	47.4	53.9	60.2	62.1	59.6	54.4	48.0	42.1
60	42.7	40.6	39.9	42.3	46.4	51.7	58.0	61.0	60.4	56.6	46.6	46.6

Note: Soil depths are in inches. The average temperatures at the 60-inch depth are for the years 1961 through 1971.

Source: Climatological Data Montana, 1951 - 1980.

Table 7.3-5

Cumulative Frequency of Occurrence of Snow Depth (Inches)

Billings Airport, Montana

Snow Depth (in.)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	22.6	35.4	54.3	83.7	98.0	99.9	100.0	100.0	98.4	93.3	71.6	44.2
Tr	38.6	52.4	69.0	90.1	99.0	100.0			99.3	96.3	79.7	57.0
1	49.9	64.2	78.1	94.3	99.4				99.9	98.5	85.7	68.5
2	58.0	74.3	82.3	96.9	99.4				100.0	99.0	89.3	79.1
3	65.7	79.3	86.0	98.0	99.6					99.4	92.4	84.3
4	70.4	83.1	89.7	98.3	99.7					99.6	94.2	86.7
5	74.4	87.6	91.9	98.4	99.7					99.7	95.5	89.0
6	78.2	89.1	94.7	98.7	99.9					99.7	96.1	90.8
7	83.7	90.4	95.7	99.0	99.9					99.7	96.9	92.4
8	88.5	92.2	97.0	99.0	00.0					99.7	97.8	93.6
9	90.8	93.3	97.4	99.1						99.7	98.4	95.3
10	92.1	94.8	98.2	99.2						99.8	98.5	96.4
11	93.2	95.3	98.5	99.4						99.8	99.1	97.4
12	95.7	96.2	98.7	99.4						99.9	99.3	98.6
13	96.6	96.7	99.1	99.4							99.5	99.0
14	97.5	97.3	99.2	99.4							99.6	99.1
15	98.4	97.4	99.2	99.5							99.8	99.2
16	99.8	98.2	99.2	99.5							99.9	99.2
17	100.1	98.7	99.2	99.5							100.1	99.2
18	100.2	98.8	99.3	99.6								99.3
19		99.7	99.4	99.6								99.3
20		99.9	99.5	99.7								99.3
21		99.9	99.6	99.7								99.4
22		100.0	100.0	99.7								99.6
23				99.7								99.6
24				99.7								100.0
25				99.7								
26				99.7								
27				99.7								
28				99.7								
29				99.7								
30				99.7								
31				99.7								
32				99.7								
33				99.8								

Note : Total frequencies may not be exactly 100.0 percent because of rounding.

"Tr" denotes trace amount.

Source: Climatological Data Montana, 1951 - 1980.

Snow generally is light, with snowfalls greater than 6 inches are uncommon. During the 30-year period between 1951 and 1980, only 26 snowfalls of more than 6 inches were measured at the Billings Airport. During this same period, there were only 6 storms that produced one-day snowfalls of more than 10 inches. These storms occurred in March 1964 (10.5 inches), January 1975 (11.7 inches), December 1978 (13.0 inches), November 1959 (13.3 inches), January 1972 (14.0 inches), and April 1955 (15.4 inches and 23.7 inches).

Because of the frequent periods of warm weather during the winter, snow seldom accumulates to significant depths. The ground is bare for extended periods during milder winters. The average monthly snow depth at the Billings Airport is zero during May through September. During the other months, average snow depths range from a trace in September to 3.2 inches during January (see Table 7.3-6). Except for the months of December, January, and February, there normally is no snow on the ground on most days. During January, the snowiest month, the ground normally is bare about 23 percent of the time (see Table 7.3-7). During the other months, the ground is free of snow from about 53 percent of the time in March and approximately 72 percent of the time in November to 100 percent of the time during July and August.

Snow accumulations greater than 6 inches are uncommon. Snow depths of 6 inches or more normally are present only about 16 percent of the time in January and 10 percent of the time in February, with lesser frequencies of occurrence during the other months. The snow occasionally accumulates to more than 12 inches during November through April. Normally, these depths of snow occur less than 4 percent of the time in January and February and only about 1 percent of the time in November, December, March, and April.

Access to the site during winter, then, is excellent. Almost never is snow a limiting factor in the dry winters in this part of Montana. For a more detailed discussion of the excellent access characteristics of the site, refer to Section 4.1 and 4.2.

7.3.3 Prevailing Wind Direction and Speed

The prevailing wind direction at the Billings Airport is southwest during all months except May, when northeast winds prevail, and December, when the prevailing wind is from the west- southwest.

An annual wind rose for the Billings Airport is presented in Figure 7.3-2. In this figure, the percentage frequencies of occurrence of winds from each of the 16 cardinal wind directions are indicated.

The mean annual wind speed at Billings is 11.3 miles per hour. December and January are the windiest months, and July and August are the least windy. Average monthly wind speeds range from 9.6 miles per hour in July and August to 13.1 miles per hour in December.

Extremely high winds are uncommon at the Billings Airport. During the years 1965 through 1978, wind speeds greater than 25 miles per hour were observed only about 1 percent of the time (see Table 7.3-8). Wind speeds greater than 40 miles per hour are rare.

7.3.4 Regional Storm Characteristics

The regional storms which affect south-central Montana include convective summer thunderstorms, rain and snowstorms associated with Pacific and Arctic frontal passages, and orographically induced precipitation due to the passage of low pressure systems to the south. Of these, the storms most likely to seriously affect construction or operation of the SSC are the heavy winter and spring snowstorms which occasionally strike the area. These storms, which may bring 12 inches or more of new snow, are uncommon. From 1951 through 1980, only six snowstorms produced more than 10 inches of new snow.

During the years 1963 through 1977, thunderstorms occurred at the Billings Airport on an average of 26 days per year. During this same period, hail was observed on an average of 1.2 days per year. Other adverse weather conditions and their average frequencies of occurrence during this time were fog (48 days per year), freezing precipitation (6 days per year), blowing snow (6 days per year), and blowing dust (0.3 days per year).

Table 7.3-6

Cumulative Frequency of 24-Hour Snowfall (Inches)

Billings Airport, Montana

Snowfall (in.)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	56.5	59.7	57.0	69.0	94.6	99.9	100.0	100.0	96.0	88.0	70.8	63.8
Tr	73.4	75.3	76.8	85.4	97.9	100.0			98.4	94.3	85.9	79.6
1	89.5	92.0	89.5	92.1	99.1				98.7	96.7	93.8	91.8
2	96.1	95.8	94.1	94.7	99.3				99.3	97.7	96.2	95.8
3	97.5	97.9	96.6	97.6	99.4				99.5	98.4	97.4	97.2
4	98.5	99.4	98.6	98.0	99.7				99.6	99.4	98.8	98.2
5	99.3	99.8	99.2	99.1	99.8				99.9	99.4	99.1	99.2
6	99.6	100.0	99.4	99.3	99.9					99.7	99.8	99.6
7	99.8	100.1	99.5	99.7						99.8	99.9	99.9
8	99.9	100.2	99.6	99.7						99.9	99.9	99.9
9	99.9		99.7	99.8						99.9	99.9	99.9
10	99.9		99.7	99.8						00.0	99.9	99.9
11	99.9		99.8	99.8							99.9	99.9
12	99.9			99.8							99.9	99.9
13	99.9			99.8							99.9	100.0
14	100.0			99.8							100.0	
15				99.8								
16				99.9								
17				99.9								
18				99.9								
19				99.9								
20				99.9								
21				99.9								
22				99.9								
23				99.9								
24				100.0								

Note : Total frequencies may not be exactly 100.0 percent because of rounding

"Tr" denotes trace amount.

Source: Climatological Data Montana, 1951 - 1980.

Table 7.3-7

Monthly Wind Speed Distribution

Billings Airport, Montana

1965 - 1978

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Calm	1.7	1.6	1.6	1.2	1.3	1.8	2.0	1.1	1.0	1.2	1.4	1.6	1.5
1.1- 3.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
3.4- 5.4	6.6	6.1	7.1	5.8	6.3	7.0	7.2	6.7	6.3	6.2	7.3	6.5	6.6
5.6- 7.6	11.2	11.9	15.8	15.6	16.8	18.7	21.1	22.1	18.8	15.3	14.6	10.9	16.1
7.8- 9.8	13.9	14.8	18.2	21.6	22.3	25.1	28.7	28.9	24.2	20.0	17.1	13.6	20.7
10.1-12.1	11.9	13.2	15.5	17.3	18.0	19.1	18.4	18.8	18.5	16.8	14.8	13.5	16.3
12.3-14.3	11.4	12.2	12.6	12.1	12.6	12.3	10.2	11.1	13.0	14.1	13.8	13.5	12.4
14.5-16.6	11.3	11.7	10.7	9.9	9.6	7.3	6.5	5.8	9.0	10.9	10.0	11.3	9.5
16.8-18.8	13.0	12.0	8.5	8.0	6.6	4.6	3.5	3.1	5.2	8.2	10.3	11.5	7.9
19.0-21.0	8.4	7.8	4.9	3.6	3.3	1.9	1.2	1.2	2.2	3.9	5.5	8.2	4.3
21.3-23.3	5.7	4.9	2.7	2.1	1.8	1.2	0.6	0.6	1.2	1.8	3.1	5.4	2.6
23.5-25.5	2.0	1.3	0.9	1.0	0.6	0.5	0.2	0.2	0.3	0.6	0.8	1.9	0.9
25.7-27.7	1.5	0.8	0.6	0.6	0.2	0.2	0.1	0.1	0.1	0.4	0.7	1.2	0.5
28.0-30.0	0.9	0.8	0.6	0.4	0.2	0.3	0.2	0.1	0.2	0.3	0.4	0.5	0.4
30.2-32.2	0.2	0.4	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.1
32.4-34.4	0.2	0.2	0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
34.7-36.7	0.0	0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36.9-38.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39.1-41.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
>41.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Av. Speed	13.4	13.0	11.6	11.6	11.0	10.3	9.6	9.8	10.5	11.4	12.1	13.2	11.4

Note: Wind speeds are in miles per hour.

Source: Montana Wind Energy Atlas, 1987 Edition

Table 7.3-8

Average Number of Days With Occurrences of Weather Phenomona

Billings Airport, Montana

1963 - 1977

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
T	0.1	0.0	0.2	1.3	3.7	6.9	6.1	4.9	2.1	0.3	0.0	0.0
A	0.0	0.0	0.0	0.0	0.3	0.5	0.2	0.1	0.1	0.0	0.0	0.0
R	1.3	0.7	1.3	4.9	5.6	4.6	0.6	2.3	4.3	4.6	1.6	0.9
S	12.1	8.2	9.6	6.9	1.3	0.1	0.0	0.0	1.1	3.3	5.8	11.0
RW	0.6	1.7	3.6	7.1	11.5	13.1	9.1	8.8	7.7	4.1	2.1	1.3
SW	2.1	2.7	4.1	2.8	0.7	0.0	0.0	0.0	0.4	0.9	2.1	1.9
L	0.0	0.0	0.1	0.9	0.7	0.5	0.1	0.3	0.4	0.5	0.3	0.0
SG	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1
SP	0.3	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1
IC	2.0	0.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4
IP	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZL	0.0	0.3	0.3	0.2	0.1	0.1	0.0	0.0	0.3	0.1	0.2	0.1
ZR	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3
BS	2.5	0.7	1.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7
BD	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
F	5.4	4.6	5.6	6.5	4.1	3.0	0.5	1.4	2.5	3.7	4.5	5.8
K	0.5	0.9	0.8	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.3	0.2

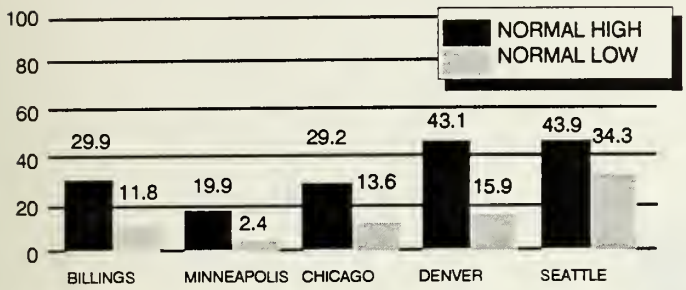
Key:

T	Thunderstorm	SP	Snow Pellets
A	Hail	IC	Ice Crystals
R	Rain	IP	Ice Pellets
S	Snow	ZL	Freezing Drizzle
RW	Rain Shower	ZR	Freezing Rain
SW	Snow Shower	BS	Blowing Snow
L	Drizzle	BD	Blowind Dust
SG	Snow Grains	F	Fog
		K	Smoke

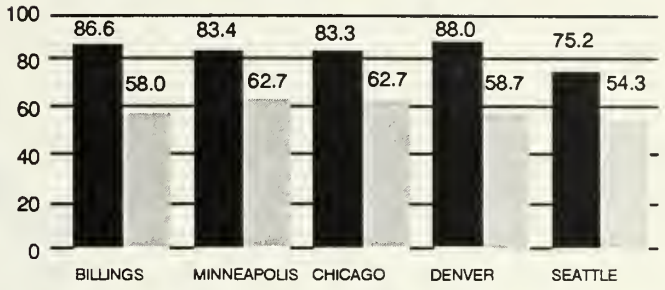
Source: Original Surface Weather Observation Forms (Form MF1-10), Billings Airport 1963 - 1977.

Figure 7.3-1 COMPARATIVE CLIMATIC DATA

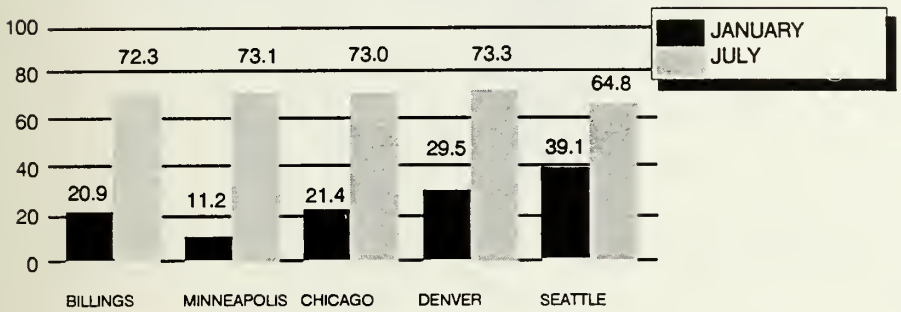
*JANUARY TEMPERATURES (F)



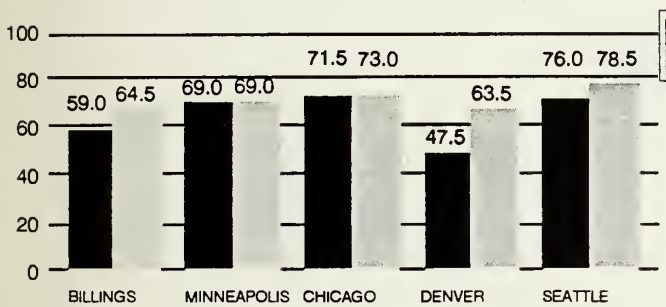
*JULY TEMPERATURES (F)



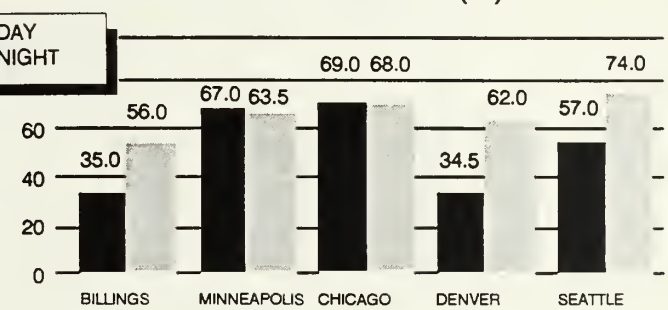
*NORMAL MONTHLY TEMPERATURES (F)



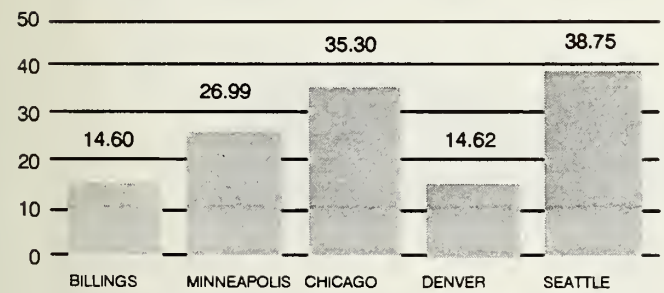
JANUARY RELATIVE HUMIDITY (%)



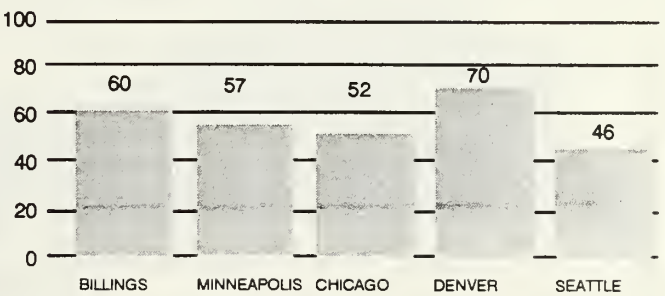
JULY RELATIVE HUMIDITY (%)



**MEAN PRECIPITATION (IN)



ANNUAL POSSIBLE SUNSHINE DAYS (%)



* Based on 1951-1980 record period. **For the period 1935-1985.
Source: Local Climatological Data, 1985 Annual Summary with Comparative Data.

STATE OF MONTANA 9/2/87

SUMMARY WIND ROSE
Billings NWS Airport
01/01/65 - 12/31/78

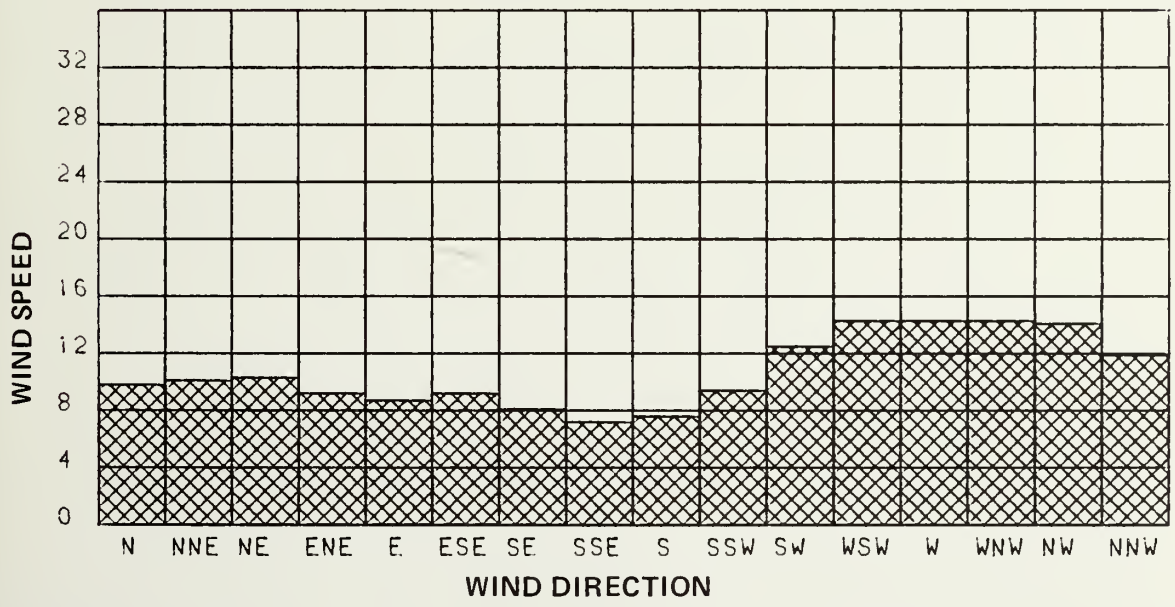


Figure 7.3-2
SUMMARY WIND ROSE

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